WHAT IS CLAIMED IS:

1. An apparatus for measuring physical properties of a plurality of material samples, the apparatus comprising:

a moveable sample holder for containing the plurality of material samples;

at least one probe for mechanically perturbing the material samples, the at least one probe having an end;

at least one actuator connected to the moveable sample holder for translating the material samples in a direction normal to the end so that the material samples contact the at least one probe; and

at least one sensor for monitoring the response of the material samples to mechanical perturbation by the at least one probe.

2. The apparatus of claim 1, wherein the sensor includes force sensors mechanically linked to the probes.

3. The apparatus of claim 2, further comprising shafts that mechanically link the force sensors to the probes.

4. The apparatus of claim 3, wherein each of the shafts includes a rigid core and an insulating outer sheathing.

5. The apparatus of claim 3, further comprising flexure strips attached to each of the shafts for aligning the probes with the material samples.

6. The apparatus of claim 3, further comprising an isolation block module for separating the probes and the force sensors.

7. The apparatus of claim 6, wherein the isolation block module has first and second surfaces and cylindrical apertures for containing the shafts, the cylindrical apertures extending from the first surface to the second surface.

8. The apparatus of claim 7, further comprising flexure strips for aligning the probes with the material samples, each of the flexure strips attached to the shafts and walls of the cylindrical apertures of the isolation block module.

9. The apparatus of claim 1, wherein the actuator is a piezoelectric stack.

10. The apparatus of claim 9, wherein the actuator includes a motorized translation slide linked to the piezoelectric stack.

11. The apparatus of claim 1, further comprising a control system for regulating environmental conditions of the material samples.

12. The apparatus of claim 8, wherein the control system includes an environmental chamber enclosing the material samples.

13. The apparatus of claim 1, wherein the force sensors are mounted on at least one flex circuit.

14. The apparatus of claim 13, wherein the force sensors are mounted on first and second flex circuits, the first flex circuit disposed above the second flex circuit.

15. The apparatus of claim 1, wherein the force sensors are pre-loaded to measure compressive and tensile forces on the probes.

16. The apparatus of claim 1, further comprising a data logger for recording responses from the sensor.

17. The apparatus of claim 1, wherein each of the probes includes at least one test fixture removeably mounted on a probe base, the probe base distal to the ends of the probes.

18. The apparatus of claim 17, wherein the at least one test fixture is magnetically coupled to the probe base.

19. The apparatus of claim 17, wherein the at least one test fixture has a blunt end for contacting the material samples.

20. The apparatus of claim 17, wherein the at least one test fixture has a sharp end for contacting the material samples.

21. The apparatus of claim 17, wherein the test fixture is bonded to at least one of the material samples.

22. The apparatus of claim 21, wherein the test fixture is oriented to either extend or compress the material sample during translation of the material samples.

23. The apparatus of claim 21, wherein the test fixture is oriented to shear the material sample during translation of the material samples.

24. The apparatus of claim 17, wherein the test fixture has a low coefficient of friction with respect to the material samples.

25. The apparatus of claim 17, wherein the test fixture includes a loop of a polymeric film.

26. The apparatus of claim 17, wherein the test fixture includes an axisymmetric well for shearing one of the material samples.

27. The apparatus of claim 26, wherein the axisymmetric well has lateral walls defining a generally cylindrical surface.

28. The apparatus of claim 26, further comprising cylindrical rods attached to the moveable sample holder, the rods in substantial axial alignment with probes.

29. The apparatus of claim 17, further comprising:

first and second reservoirs; and

a tube having a generally cylindrical inner bore, the tube providing fluid communication between the first and second reservoirs;

wherein the sample holder includes a piston disposed in the first reservoir for forcing one of the material samples initially contained in the first reservoir through the tube and into the second reservoir.

30. The apparatus of claim 1, wherein the apparatus is capable of measuring at least one physical property of at least eight samples simultaneously.

31. The apparatus of claim 1, wherein the apparatus is capable of measuring at least one physical property of at least forty-eight samples simultaneously.

32. The apparatus of claim 1, wherein the apparatus is capable of measuring at least one physical property of at least ninety-six samples simultaneously.

33. The apparatus of claim 1, wherein the apparatus is capable of measuring at least two different physical properties of the samples simultaneously.

34. The apparatus of claim 33, wherein the test methods used to measure said at least two different physical properties are selected from the group consisting of flexure, uniaxial extension, biaxial compression, shear, indentation, stress and strain at failure, toughness, tack, loop tack, viscosity, melt flow indexing, storage modulus, and loss modulus.

35. A system for screening a combinatorial library of materials by measuring physical properties of the materials, the system comprising:

an array of a plurality of material samples;

at least one probe for mechanically perturbing the plurality of material samples, the at least one probe having an end;

at least one actuator for translating the plurality of material samples in a direction normal to the end so that the material samples contact the at least one probe; and

at least one sensor for monitoring the response of the plurality of material samples to mechanical perturbation by the at least one probe.

36. The system of claim 35, wherein the array of material samples comprises a flexible substrate coated with materials at discrete predefined regions.

37. The system of claim 36, further comprising a pair of perforated plates, wherein the flexible substrate is either sandwiched between the perforated plates or bonded to at least one of the perforated plates.

38. The system of claim 35, wherein the array of material samples comprises a rigid substrate coated with materials at discrete predefined regions.

39. The system of claim 38, wherein the rigid substrate has a low coefficient of friction with respect to the material samples.

40. The system of claim 38, wherein the materials are bonded to at least one of the rigid substrate and the end of the at least one probe.

41. The system of claim 40, wherein the array of material samples and the probes are oriented either to extend or compress the materials during translation of the array material samples.

42. The system of claim 40, wherein the array of material samples and the probes are oriented to shear the materials during translation of the array of material samples.

43. The system of claim 35, wherein the array of material samples comprises cylindrical rods coated with materials.

44. The system of claim 35, wherein the system is capable of screening at least twelve materials simultaneously.

45. The system of claim 35, wherein the system is capable of screening at least forty-eight materials simultaneously.

46. The system of claim 35, wherein the system is capable of screening at least ninety-six materials simultaneously.

47. The system of claim 35, wherein the system is capable of screening the array of material samples based on measurements of at least two different physical properties.

48. The system of claim 47, wherein the test methods used to measure the at least two physical properties are selected from the group consisting of flexure, uniaxial extension, biaxial compression, shear, indentation, stress and strain at failure, toughness, tack, loop tack, viscosity, melt flow indexing, storage modulus, and loss modulus.

49. A method of screening a combinatorial library of materials comprising:

mechanically perturbing an array of a plurality of materials by contacting at least two of the materials simultaneously with probes; and

monitoring the response of the materials to the mechanical perturbations.

50. The method of claim 49, wherein monitoring the response of the materials to the mechanical perturbations includes measuring forces exerted on the probes by the material samples as functions of displacement between the probes and the materials.

51. The method of claim 50, wherein monitoring the response of the material samples to the mechanical perturbations includes measuring forces exerted on the probes by the materials as functions of time.

52. The method of claim 49, further comprising relating the response of the array of materials to Young's modulus, hardness, viscosity, storage modulus, or loss modulus.

53. The method of claim 49, wherein the method is capable of screening at least twelve materials simultaneously.

54. The method of claim 49, wherein the method is capable of screening at least forty-eight materials simultaneously.

55. The method of claim 49, wherein the method is capable of screening at least ninety-six materials simultaneously.

56. The apparatus of claim 17, wherein the movable sample holder comprises a frame and at least two cups, which are slidable mounted to the frame, and at least two intersecting substrate pieces, with one of said pieces being attached to the frame and the other of said pieces being attached to the cups.

57. The apparatus of claim 17, wherein the moveable sample holder comprises a frame and at least two weights, positioned in receptacles in the frame, with a known surface positioned parallel to the at least one end on which the material sample is deposited.

58. The apparatus of claim 17, wherein the test fixture comprises a spring poppet with a cap, said cap having a known surface positioned parallel to the plurality of materials samples.